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A Comparative Study between Different Surgical Techniques of Nasal Valve Collapse Repair

Thesis

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Abstract

This study includes 20 patients and aims to evaluate different surgical techniques for the functional correction of nasal obstruction caused by nasal valve collapse. Patients were subjected to a pre and postoperative subjective and objective evaluation and divided in two groups: (group A) the alar batten graft technique, (group B) the butterfly or spreader graft techniques. The results indicate that each of these techniques is successful in treating nasal valve collapse and give similar results to the others.

Key words: *nasal valve collapse, alar batten graft, butterfly graft, spreader graft, NOSE score.*

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Introduction

The nasal valve is the important region responsible for air flow and nasal resistance. Collapse of this critical region produces nasal obstruction and characteristic nasal contour deformities. The nasal valve is a prominent factor when planning cosmetic and functional rhinoplasty (Miller and Constantinides, 1999).

The nasal valve was first described by Mink in 1903, and its anatomy was defined by Bridgeras the flow-limiting segment of the nasal airway that was located at the triangular aperture between the upper lateral cartilage (ULC) and the septum (Lee and Glasgold, 2001).

The nasal valve consists of two distinct regions, the external and internal valves, the internal nasal valve refers to the cross-sectional area bordered by the junction of the caudal portion of the upper lateral cartilage and the nasal septum, the external nasal valve is composed of the cutaneous and skeletal support of the mobile alar wall up to and including its free edge at the nostril opening (Becker and Becker, 2003).

The nasal valve contributes 50% of the total airway resistance within the respiratory tract when it is functioning normally. The percentage is even higher if an abnormality exists. The valve acts to regulate nasal airflow through collapse and dilation during breathing. Weakened nasal sidewall or valvular narrowing allows collapse to occur producing symptoms of nasal obstruction (Hurbis, 2006).

Nasal valve dysfunction has a role in many cases complaining of chronic nasal obstruction, and yet the static and dynamic contributions of the nasal valve continue to be overlooked by many otorhinolaryngologists (Schlosser and Park, 1999).

Static narrowing of the nasal valve area is caused by crowding of its anatomic components. Dynamic insufficiency of this valve is caused by a flaccid lateral nasal wall that may collapse when a critical transnasal pressure is reached (Egan and Kim, 2005).

Although many literatures has included several reports regarding nasal valve obstruction, the rarity of this condition as a cause of nasal blockage makes it a diagnostic challenge (Khosh et al, 2004).

Collapse of the nasal valve is often related to deficiencies in the lateral nasal wall structural support. Iatrogenic injury, as may occur with rhinoplasty, is one of the most common causes of lateral nasal wall weakness. In addition, trauma, aging, and congenitally flaccid upper lateral cartilages may also cause nasal valve collapse. It has been shown that the mean cross-sectional area of the nasal valve decreases by 22% to 25% after reduction rhinoplasty (Akcam et al, 2004).

To correct valve dysfunction, the physician must begin with an accurate preoperative diagnosis with focus on the precise site of deficiency and a distinction between static and dynamic dysfunction (Schlosser and Park, 1999).

The multiple factors involved in nasal valve collapse often demand multiple approaches. Numerous methods have been described for correction of valve collapse, which attest that no single approach has been universally successful (Mendelsohn and Golchin, 2006).

Alar batten grafting is a workhorse technique in functional rhinoplasty for widening and strengthening the supra-alar lateral nasal wall. This cartilaginous batten graft is placed into a precise pocket within the deep tissue of the lateral wall. The graft serves to stent the supra-alar lateral nasal wall and resist against its collapse, thus addressing both static and dynamic components of obstruction (Egan and Kim, 2005).

The most widely used of these operations involves placing rectangular cartilage grafts, so called spreader grafts, subperichondrally between the septum and the upper lateral cartilage as described by Sheen in 1984. Therefore, correcting the collapse of the lateral walls while keeping them apart permits the widening of the internal nasal valve, thus correcting the patency of the nasal airway spaces (Bottini et al, 2007).

Butterfly grafts are designed to improve valve dysfunction through onlay support and by taking advantage of the intrinsic curvature of conchal cartilage. They are placed at the scroll area between the upper lateral cartilage and lower lateral cartilage in an attempt to widen the valve angle (Schlosser and Park, 1999).

Aim of the work

The aim of this study is to evaluate different surgical techniques for the functional correction of nasal obstruction caused by nasal valve collapse.

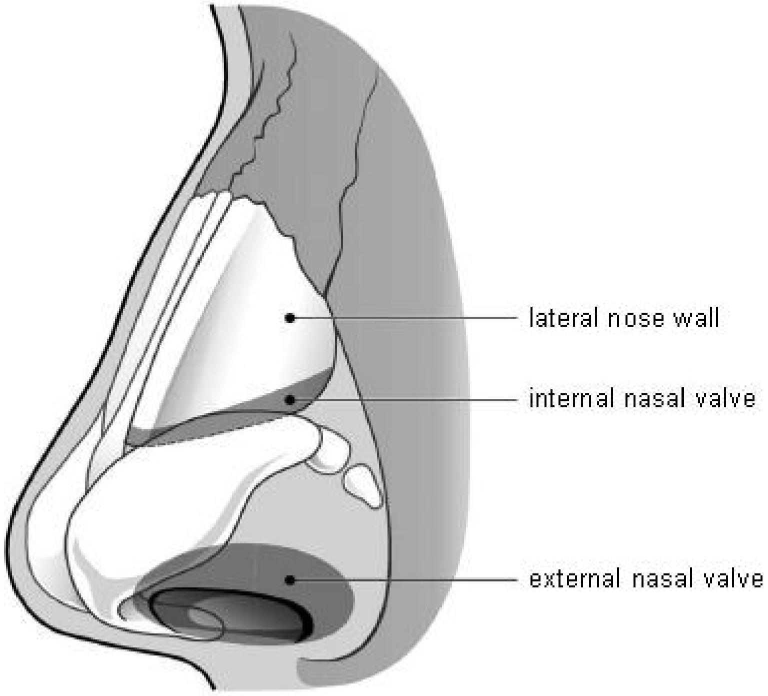
Anatomy and physiology of nasal valve

Anatomic consideration:

2000 years ago, Galen described the anatomy of the nose and its functions for the first time. The term of nasal valve, however, has been coined by Mink (1903) not before the beginning of the 20th century and has been characterized in more detail by Bridger (1970).

There has been a controversy on the exact localization and definition of the nasal valve in the past. Rhinoplasty surgeons prefer the division into an external and internal nasal valve. Physiologists rather speak of the nasal valve area as “flow limiting segment”. This is the place of maximum flow resistance. The elongated opening between the caudal end of the lateral cartilage and the medial nasal septum constitutes the actual internal (inner) nasal valve. It is also called “ostium internum nasi” (Bloching, 2007).

The movable, airflow-regulating part of the nose, which corresponds to the lateral nasal cartilage designate the term nasal valve. The slit like opening formed by its caudal edge laterally and the septum medially was thought to be particularly important in nasal respiration. This two-dimensional region is nowadays looked upon as the actual nasal valve. The broader term nasal valve area is used for the three-dimensional (3-D) nasal segment that includes the septum, the caudal end of the lateral nasal cartilage, the soft tissue overlying the pyriform aperture and floor of the nose, and the head of the inferior turbinate (Bruintjes et al, 1998).



Fgure 1: Presentation of the external and internal nasal valve:
The external nasal valve is located in the area of the nostrils and is limited in the lateral direction by the caudal portion of the alar cartilage with the connected soft parts and in the medial direction by the columella. The internal nasal valve is an elongated opening. It is located in the upper area of the nasal valve area between the anterior septum and the caudal lateral cartilage (Bloching, 2007).

The nose can be divided into the upper third, consisting of the nasal bones, and the lower two thirds, consisting of cartilage and soft tissue. The lower two thirds can be subdivided into the tip and the middle vault. The middle vault consists of the upper lateral cartilages (ULCs), which are roughly triangular in shape. The upper lateral cartilages insert onto the ventral surface of the nasal bones superiorly and loosely to the pyriform apertures of the maxilla laterally. Inferiorly, the scroll of the ULC is connected via fibrous attachments to the lateral crura of the alar cartilages. This relationship is responsible for one of the major tip support mechanisms. Medially, the upper lateral cartilages are connected to the quadrangular cartilage of the nasal septum, forming one of the most significant functional areas in the nose.

The middle nasal vault is significant for its aesthetic and functional properties. This area is a transition zone between the nasal tip and nasal bones and plays an important role in profile, tip projection, tip rotation, and tip support. Likewise, the middle vault contains the internal nasal valve, an important regulator in nasal airflow.

Rhinoplasty must be tailored to the aesthetic and functional needs of the patient. Proposed aesthetic and functional alterations are determined by a thorough preoperative analysis. Consideration of aesthetic modification of the middle vault requires an overview of the anatomy and anatomic relationships of the middle vault (Prendiville et al, 2002).

The lateral nasal wall is divided into three parts: (1) the bone-cartilage chain, (2) the hinge area and (3) the wing of the nose.

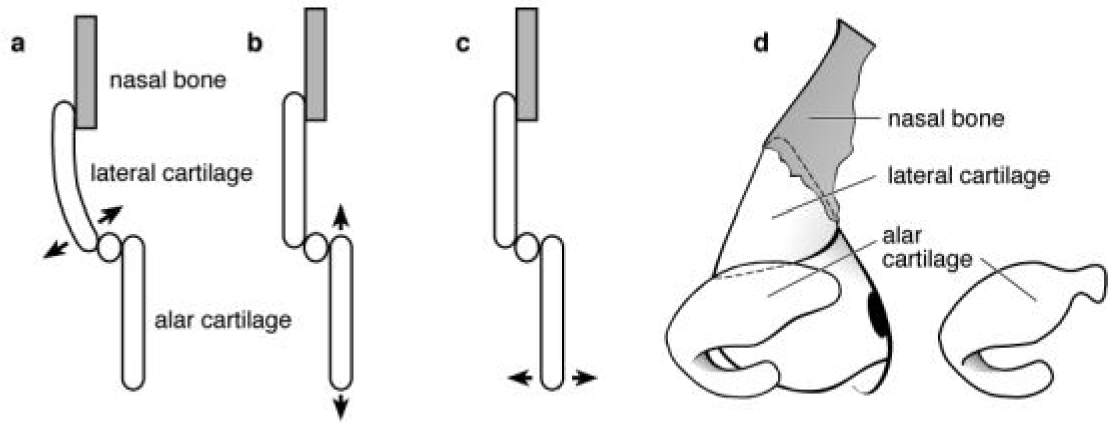


Figure 2: The lateral nasal wall is divided into three parts: the bone-cartilage chain, the mobile hinge area in the region of the nasal valve and the soft-tissue wings of the nose. The intercartilaginous region between the alar cartilage and the lateral cartilage can be seen as a diarthrosis with two degrees of freedom (translation and rotation) (Bloching, 2007).

The back edge of the lateral cartilage is firmly connected to the nasal bone. Here, the cartilage partially lies under the bone and the perichondrium passes continuously into the periostium. The lateral cartilages continuously pass into the cartilaginous septum and form a firm connection; they can be separated in the caudal portion only. The intercartilaginous (IC) region is anatomically constant. The cephalic edge of the alar cartilage normally projects over the caudal edge of the lateral cartilages without touching them. In addition, in most cases, cartilaginous sesamoids of varying number and size are found in the IC region. The nasal cartilages are surrounded by perichondrium and are connected to each other through band-like firm cords of connective tissue.

Theoretically, the IC joint can be seen as diarthrosis with two degrees of freedom and is secured through taut connective tissue between lateral and alar cartilages. Sesamoid cartilages that might have some sort of ball bearing function are found between them. Translational and rotational movements are observed in this joint. Furthermore, the elastic properties of the alar cartilage make an inward and an outward deflection possible (Bloching, 2007).

In addition to the elasticity of the cartilage, this depends on the free lower end of the lateral crus and the tough connection to the lateral cartilage. It has to be noted as well that any torsional forces in the area of the alar cartilage are associated with a deflection of the lateral cartilages. The bone-cartilage chain of the nose has to be seen as a functional unit made up of the individual components mentioned above.

The perinasal musculature mainly originates in the maxilla or in the alar cartilage and inserts at the skin, at the aponeurosis of the nasal dorsum or the crura of the alar cartilages. The lateral cartilage is free of any muscle attachments or origins of muscles.

Concerning the nasal valve, there are only two important muscles with opening function.

- The dilatator naris that originates at the lateral crus of the alar cartilage and inserts into the skin of the wing of the nose. It has a stabilizing function on the external nasal valve and widens the nasal aperture. It only has an indirect effect on the nasal valve through a consecutively caused outward deflection of the caudal end of the lateral cartilage and thus opening of the area of the nasal valve.
- The second important muscle is the pars alaris of the M. nasalis. It originates in the incisive fossa of the maxilla and inserts at the accessory cartilages and the skin in the region of the hinge area. This enables it to pull this structure in the lateral direction in case of innervation and thus to widen the internal nasal valve (Bloching, 2007).

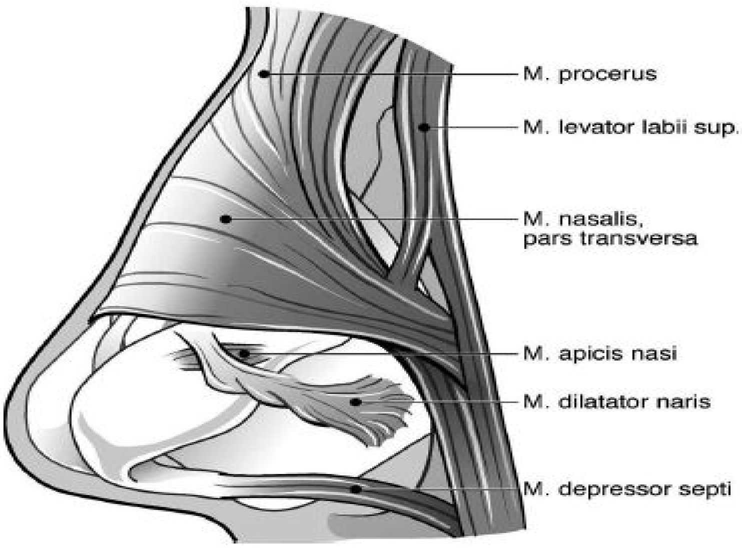


Figure 3: Presentation of the perinasal musculature:
The internal nasal valve is widened by the M. dilatator naris originating from the lateral alar cartilage and the pars alaris of the M. nasalis. An excessively lateral preparation of the alar cartilage may damage the origin of the M. dilatator naris and destabilise the internal nasal valve (Bloching, 2007).

The “swell body at the nasal septum” described for the first time by Wustrow (1951) also is of functional importance in the area of the inner nasal valve. Macroscopically, this is a bloated area of the size of 1 to 5 mm of the cartilaginous- bony septum with thickened mucosa. This swell body is located above the lower and before the middle turbinate. This structure is hardly taken note of clinically – although it can be visualized well in the CT and is often misinterpreted as high septal deviation. Samples examined of the nasal mucosa from the area of the lower nasal turbinate, the septum and the swell body of the septum of healthy subject showed mainly glands and clearly less venous sinusoids compared to the mucosa of the lower nasal turbinate. It seems that this region has a regulatory effect on the airflow and secretory functions.

Thus, the nasal valve area is not a singular structure, but a complex, three-dimensional construct consisting of various morphological structures namely the "flow limiting segment". The cross section areas of the passages through which air flows turn from asymmetrical-oval in the area of the nostrils to an upright-elongated and narrow shape in the nasal valve area (Bloching, 2007).

The internal nasal valve is defined as the area between the caudal end of the upper lateral cartilages and the cartilaginous septum. This angle is normally 10° to 15° in the white (leptorrhine) nose and is more obtuse in African American and Asian (platyrrhine) noses (Schlosser and Park, 1999).

The external valve is composed of the dense connective tissue that surrounds the sesamoid cartilages. This dense fibrous tissue also connects the upper lateral cartilage and the lateral crura of the lower lateral